

MEMORANDUM OF UNDERSTANDING
BETWEEN THE
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
OF THE UNITED STATES OF AMERICA
AND THE
CANADIAN SPACE AGENCY
CONCERNING COOPERATION ON THE
CIVIL INTERNATIONAL SPACE STATION

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The National Aeronautics and Space Administration (hereinafter "NASA"),

and

The Canadian Space Agency (hereinafter "CSA"),

Recalling that in his State of the Union Address of January 25, 1984, the President of the United States directed NASA to develop and place into orbit a permanently manned Space Station and invited friends and allies of the United States to participate in its development and use and to share in the benefits thereof, in order to promote peace, prosperity and freedom,

Recalling the acceptance of such invitation by the Prime Minister of Canada at the March 1985 Quebec Summit meeting with the President of the United States and the mutual confirmation of their intention to cooperate at the March 1986 Washington, D C., Summit meeting,

Having successfully implemented the Memorandum of Understanding between NASA and the Ministry of State for Science and Technology of Canada (MOSST) for a Cooperative Program Concerning Detailed Definition and Preliminary Design (Phase B) of a Permanently Manned Space Station, which entered into force on April 16, 1985,

Considering the Agreement among the Government of the United States of America, Governments of Member States of the European Space Agency, the Government of Japan and the Government of Canada on Cooperation in the Detailed Design, Development, Operation and Utilization of the Permanently Manned Civil Space Station signed on September 29, 1988, as superseded by the Agreement among the Government of Canada, Governments of Member States of the European Space Agency, the Government of Japan, the Government of the Russian Federation, and the Government of the United States of America concerning Cooperation on the Civil International Space Station, (hereinafter "the Intergovernmental Agreement") and particularly Article 4 thereof,

Considering the Memorandum of Understanding between NASA and the Ministry of State for Science and Technology of Canada (MOSST) on Cooperation in the Detailed Design, Development, Operation and Utilization of the Permanently Manned Civil Space Station signed on September 29, 1988, and recognizing that upon its establishment on March 1, 1989, the Canadian Space Agency (CSA) assumed responsibility for the execution of the Canadian Space Station program,

Considering the Memorandum of Understanding between NASA and the European Space Agency (ESA) on Cooperation in the Detailed Design, Development, Operation and Utilization of the Permanently Manned Civil Space Station signed on September 29, 1988,

Considering the Memorandum of Understanding between NASA and the Government of Japan (the GOJ) on Cooperation in the Detailed Design, Development, Operation and Utilization of the Permanently Manned Civil Space Station signed on March 14, 1989, and recognizing that the GOJ has designated the Science and Technology Agency of Japan (STA) in that Memorandum of Understanding as its Cooperating Agency, as provided for in Article 4 of the Intergovernmental Agreement,

Recognizing the Joint Invitation extended to the Government of the Russian Federation at the Occasion of the Intergovernmental Meeting of the Space Station Partners in Washington, D.C., on December 6, 1993, and further recognizing the acceptance of the invitation by the Government of the Russian Federation on December 17, 1993,

Considering the Interim Agreement between NASA and the Russian Space Agency (RSA) for the Conduct of Activities Leading to Russian Partnership in the Detailed Design, Development, Operation and Utilization of the Permanently Manned Civil Space Station signed on June 23, 1994,

Considering the Arrangements For Enhanced Cooperation In Space Between NASA and CSA of May 18, 1994,

Considering the Implementing Arrangement Between NASA and CSA for the provision, by Canada, of a Space Station Special Purpose Dexterous Manipulator and other goods and services towards fulfilment of its financial responsibilities for common system operations costs signed on January 28, 1998,

Recognizing that NASA and CSA, NASA and ESA, NASA and the GOJ, and NASA and RSA have prepared Memoranda of Understanding in conjunction with their Governments' negotiation of the Intergovernmental Agreement,

Convinced that this cooperation among NASA, CSA, ESA, the GOJ and RSA (hereinafter the "partners"), implementing the provisions established in the Intergovernmental Agreement, will further expand cooperation through the establishment of a long-term and mutually beneficial relationship and will further promote cooperation in the exploration and peaceful use of outer space,

Have agreed as follows:

Article 1

Purpose and Objectives

1.1. The purpose of this Memorandum of Understanding (hereinafter "MOU") is, pursuant to Article 4 of the Intergovernmental Agreement and on the basis of genuine partnership, to establish arrangements between NASA and CSA (hereinafter "the Parties") implementing the provisions of the Intergovernmental Agreement, in accordance with international law. This MOU implements, is intended to be consistent with, and is subject to the provisions of the Intergovernmental Agreement. Additional arrangements implementing provisions of this MOU, as agreed pursuant to Article 4.2 of the Intergovernmental Agreement between duly authorized representatives of the Parties, are subject to this MOU. Implementing arrangements include amendments to any existing arrangements that may be agreed between the Parties in the course of their Space Station cooperation under this MOU.

1.2. The specific objectives of this MOU are:

- to provide the basis for cooperation between NASA and CSA in the detailed design, development, operation and utilization of the permanently inhabited civil international Space Station for peaceful purposes, in accordance with international law;
- to detail the roles and responsibilities of NASA and CSA, taking into account the roles and responsibilities of ESA, the GOJ and RSA in the detailed design, development, operation and utilization of the Space Station and also to record the commitments of NASA and CSA to each other and to ESA, RSA and the GOJ;
- to establish the management structure and interfaces necessary to ensure effective planning and coordination in the conduct of the detailed design, development, operation and utilization of the Space Station;
- to provide a basis for cooperation that maximizes the total capability of the Space Station to accommodate user needs and that ensures that the Space Station is operated in a manner that is safe, efficient and effective for both Space Station users and Space Station operators; and
- to provide a general description of the Space Station and the elements comprising it.

Article 2

General Description of the Space Station

2.1. NASA, CSA, the GOJ, ESA, and RSA will join their efforts, under the lead role of NASA for overall management and coordination, to create an integrated international Space Station (hereinafter "the Space Station"). NASA and RSA, drawing on their extensive experience in human space flight, will produce elements which serve as the foundation for the Space Station. The GOJ and ESA will produce elements that will significantly enhance the Space Station's capabilities. CSA's contribution will be an essential part of the Space Station.

2.2. The Space Station will be a unique, permanently inhabited multi-use facility in low Earth orbit, with flight elements provided by all the partners and Space Station-unique ground elements to support the operation and utilization of the elements on orbit.

2.3. The Space Station will enable its users to take advantage of human ingenuity in connection with its low-gravity environment, the near-perfect vacuum of space and the vantage point for observing the Earth and the rest of the Universe. Specifically, the Space Station and its evolutionary additions could provide for a variety of capabilities, for example:

- a laboratory in space, for the conduct of science and applications and the development of new technologies;
- a permanent observatory in high-inclination orbit, from which to observe Earth, the Solar System and the rest of the Universe,
- a transportation node where payloads and vehicles are stationed, assembled, processed and deployed to their destination;
- a servicing capability from which payloads and vehicles are maintained, repaired, replenished and refurbished;
- an assembly capability from which large space structures and systems are assembled and verified;
- a research and technology capability in space, where the unique space environment enhances commercial opportunities and encourages commercial investment in space,
- a storage depot for consumables, payloads and spares; and
- a staging base for possible future missions, such as a permanent lunar base, a human mission to Mars, robotic planetary probes, a human mission to survey the asteroids, and a scientific and communications facility in geosynchronous orbit.

Article 3

Space Station Elements

3.1. The Space Station will consist of elements provided by the partners comprising both flight elements and Space Station-unique ground elements. The elements are summarized in the Annex to the Intergovernmental Agreement and are further elaborated in this Article. Their requirements are defined and controlled in appropriate program documentation as provided for in Article 7

3.2. NASA Space Station Flight Elements: NASA will design, develop and provide on-orbit the following flight elements including subsystems, the U.S. Extravehicular Activity (EVA) system, flight software and spares as required.

- one permanently attached Habitation Module with complete basic functional outfitting to support habitation for four crew members, including primary storage of crew provisions and the health maintenance system;
- one permanently attached multipurpose Laboratory Module, located so as to contain the optimum microgravity environment of the Space Station payload accommodations, with complete basic functional outfitting, including accommodations for International Standard Payload Racks and provisions for storage of NASA spares, and secondary storage of crew provisions;
- one permanently attached Centrifuge Accommodation Module, with complete basic functional outfitting, a centrifuge rotor, and accommodations for International Standard Payload Racks which will contain a glovebox and specimen habitats;
- three Nodes which provide pressurized volume for crew and equipment and connections between Space Station pressurized elements,
- Truss Assembly which provides Space Station structure for attaching elements and systems;
- four accommodation sites for external payloads attached to the Space Station Truss Assembly;
- Solar Photovoltaic Power Modules and associated power distribution and conditioning equipment which serve as the primary Space Station electrical power source, providing an average of 75kW;
- one FGB Energy Block, a self-sufficient orbital transfer vehicle which contains propulsion, guidance, navigation and control, communications, electrical power, thermal control systems, and stowage capacity (hereinafter "FGB");
- one airlock for purposes of crew and equipment transfer with the capability to accommodate U.S. and Russian space suits;
- crew rescue vehicle with capabilities to support the rescue and return of a minimum of four crew,
- logistics carriers which provide the delivery of water, atmospheric gases and crew supplies and delivery and return of dry cargo, including crew supplies, logistics and scientific equipment, and
- one Mobile Transporter (MT) which will serve to provide translation capability for the Mobile Servicing Center (MSC).

3.3. Canadian Space Station Flight Elements: The Canadian elements will be developed to play the predominant role in satisfying the following functions for the Space Station:

- attached payload servicing (external);
- Space Station assembly;
- Space Station maintenance (external);
- transportation on Space Station;
- deployment, retrieval and berthing; and
- EVA support.

3.3.a. CSA will design, develop and provide the following flight elements of the Mobile Servicing System, including subsystems, flight software and agreed spares as required:

- The Space Station Remote Manipulator System (SSRMS);
- The Mobile Remote Servicer Base System (MBS); and
- One Special Purpose Dexterous Manipulator (SPDM).

The SSRMS, the MBS and the NASA-provided Mobile Transporter comprise the Mobile Servicing Center (MSC). The MSC together with the SPDM comprise the Mobile Servicing System (MSS).

3.4. ESA, RSA and the GOJ Space Station Flight Elements: As reflected in the MOU between NASA and ESA and in the MOU between NASA and the GOJ and the MOU between NASA and RSA:

3.4.a. ESA Space Station Flight Elements: ESA will design, develop and provide on orbit the following flight elements including subsystems, flight software and spares as required:

- one European pressurized laboratory permanently attached to the Space Station, with complete basic functional outfitting including accommodations for International Standard Payload Racks and accommodations for external payloads, and provisions for storage of ESA spares and secondary storage of crew provisions;
- logistics carriers which provide system operations support, user logistics and on-orbit supply; and
- orbital transfer vehicles which provide thrust capability for orbit adjustments (reboost).

3.4 b The GOJ Space Station Flight Elements: The GOJ will design, develop and provide on orbit the following flight elements including subsystems, flight software and spares as required.

- One Japanese Experiment Module (JEM), a permanently attached multipurpose research and development laboratory, consisting of a pressurized module, an Exposed Facility and at least two Experiment Logistic Modules, and including a scientific equipment airlock, the JEM remote manipulator and IVA control/monitoring of the JEM Remote Manipulator System (JEM-RMS), with complete basic functional outfitting, including accommodations for International Standard Payload Racks and provisions for storage of the GOJ spares and secondary storage of crew provisions; and

- logistics carriers which provide system operations support, user logistics and on-orbit supply.

3.4.c. RSA Space Station Flight Elements: RSA will design, develop and provide on orbit the following flight elements including subsystems, the RSA Extravehicular Activity (EVA) system, flight software and spares as required:

- Service Module providing a capability for attitude control and reboost with complete basic functional outfitting to support habitation of three crew members;

- two Life Support Modules to accommodate additional equipment to support Space Station crew and supplement the life support functions present in the Service Module;

- two Docking Compartments to support EVA for assembly and operations;

- Universal Docking Module, which includes gyrodynes to provide docking and pressurized access to the Russian elements and a capability to support research activities;

- Science Power Platform which will provide an average of 19 kW and which includes Autonomous Thrusting Facilities, power distribution and conditioning equipment, accommodation sites for external payloads and a remote manipulator system;

- two Research Modules with a complete set of equipment to support research activities,

- Soyuz TM vehicle to provide on-orbit shelter, crew rescue and emergency crew return functions in accordance with technical capabilities of one permanently docked Soyuz TM vehicle;

- Progress vehicle to provide Space Station reboost capabilities and delivery of infrastructure elements, propellant, water, atmospheric gases and delivery and return of dry cargo, including crew supplies, logistics and scientific equipment; and

- Docking and Stowage Module to accommodate additional stowage and support Soyuz docking.

3.5 Space Station-unique ground elements will be provided by NASA, CSA and the other partners. These elements will be adequate to support the detailed design and development

(including assembly and verification), the continuing operation and the full international utilization of each partner's flight elements listed above. The requirements for these elements will be defined and controlled in appropriate program documentation as provided for in Article 7.

3.5.a. NASA will provide the following Space Station-unique ground elements: equipment required for specialized or unique integration or, as the case may be, for launch or return to Earth; ground support equipment (GSE) and flight support equipment (FSE) including necessary logistics; engineering support centers and user support centers; test equipment, mock-ups, simulators, crew training equipment, software and any facilities necessary to house these items; the Space Station Control Center (SSCC); the Payload Operations Integration Center (POIC); the Space Station Training Facility (SSTF); Space Station verification and test facilities; subsystem testbeds; and elements related to logistics support and to software development, integration, test and verification.

3.5.b. As will be agreed and documented in the program documentation as provided for in Article 7, CSA will provide the following Space Station-unique ground elements: equipment required for specialized or unique integration or, as the case may be, for launch or return to Earth; GSE and agreed FSE including necessary logistics; operations support centers; engineering support centers; and test equipment, mock-ups; simulators, facilities, crew training equipment and software, and any facilities required to house these items.

3.5.c. As reflected in the MOU between NASA and the GOJ and in the MOU between NASA and ESA, and in the MOU between NASA and RSA, the GOJ, RSA and ESA will provide, the following Space Station-unique ground elements: equipment required for specialized or unique integration or, as the case may be, for launch or return to Earth; GSE and FSE including necessary logistics; operations control centers, including, in the case of RSA, Mission Control Center-Moscow, engineering support centers and user support centers; and test equipment, mock-ups; simulators, crew training equipment, software and any facilities necessary to house these items.

Article 4

Access to and Use of the Space Station

4.1. NASA and CSA will each assure access to and use of their Space Station flight elements listed in Article 3.

4.2. The partners' utilization of flight elements listed in Article 3 will be equitable, as provided in the allocation commitments set forth in Article 8 of this MOU and of the corresponding MOU between NASA and ESA and the MOU between NASA and the GOJ and the MOU between NASA and RSA. Beyond these allocation commitments, the capabilities of the Space Station will be made available to the partners subject to specific arrangements between the relevant partners.

4.3. In accordance with the procedures in Article 8, NASA and CSA will each assure access to and use of their Space Station-unique ground elements referred to in Article 3.5 by each other and the other partners in order to support fully the utilization of the flight elements in accordance with the Consolidated Operations and Utilization Plan provided for in Article 8.1.c. As provided in Article 8, NASA and CSA will each also assure access to and use of their Space Station-unique ground elements by each other and the other partners for system operations support.

4.4. As requested by either Party for its detailed design and development activities, access to and use of the Space Station-unique ground elements provided by either Party will be granted on a space-available basis and subject to specific arrangements.

Article 5

Major Program Milestones

5.1. The Space Station programs of NASA and CSA each include detailed design and development. The NASA and CSA programs also include Space Station operation and utilization. Because of the extended period required to assemble the Space Station, detailed design and development activities will overlap operation and utilization activities. After the completion of detailed design and development which includes assembly of the Space Station and one year of initial operational verification (hereinafter "detailed design and development"), mature operations and utilization will begin.

5.2. Major target milestones for the Space Station are as follows:

- First NASA-provided Space Station Element (launched by RSA) 1998
- Permanent Human Presence Capability 1999
(habitation and crew rescue capability for three crew)
- NASA-provided Laboratory Module launch 1999
- CSA Space Station Remote Manipulator System launch 1999
- NASA Mobile Transporter launch 2000
- CSA Mobile Remote Servicer Base System launch 2000
- CSA Special Purpose Dexterous Manipulator launch 2002
- Assembly Complete 2003
(assembly of all permanently attached elements listed in Article 3)
- Initiation of Mature Operations and Utilization 2004

5 3 NASA and CSA will develop, maintain and exchange coordinated implementation schedules. These schedules, including the dates for the above milestones, the delivery dates for the CSA-provided elements and the NASA-provided elements, and the assembly sequence for all elements of the Space Station, will be updated as necessary and formally controlled as described in Article 7

Article 6

Respective Responsibilities

6.1. NASA Responsibilities

6.1.a While undertaking activities related to the detailed design and development of the Space Station elements described in Articles 3.2 and 3.5.a, and within the scope of the Parties' responsibilities established elsewhere in this MOU, NASA will:

1. provide overall program management and coordination for detailed design and development of an integrated Space Station and manage the detailed design and development of the NASA-provided elements;
2. participate with CSA and the other partners in Space Station program management mechanisms as provided in Articles 7 and 8;
3. perform overall system engineering and integration, with participation of CSA and the other partners as necessary, which includes integrated risk management activities, and perform system engineering and integration and risk management for NASA-provided elements;
4. establish in Canada and accommodate in the U.S. agreed liaison personnel as provided in Article 7.3;
5. provide regular progress and status information on overall Space Station and NASA Space Station program activities and plans in accordance with the documents described in Article 7.2;
6. conduct overall Space Station technical reviews, including integrated design, critical design, design certification, safety and mission assurance, operations readiness and flight readiness reviews, in order for NASA to certify, following the certifications at element level by each partner for the element it provides, that all Space Station infrastructure and accommodations elements to be launched on the Space Shuttle are acceptable for launch, on-orbit assembly and orbital operations and accommodate CSA representation as necessary for NASA and CSA to fulfill their respective responsibilities under this MOU;
7. conduct for the elements it provides: technical reviews, including integrated design, critical design, safety and mission assurance and other reviews as set forth in the documents described in Article 7.2; and provide for CSA and other partner participation as necessary for NASA and CSA to fulfill their respective responsibilities under this MOU;

8. provide for CSA participation in other partners' technical reviews as necessary for NASA and CSA to fulfill their respective responsibilities under this MOU;

9. participate in, as appropriate, and provide information as necessary for CSA to conduct the reviews identified in Article 6.2.a 6;

10. provide to CSA program, systems requirements, technical interface, systems design and systems operations information necessary for the integration of the CSA-provided elements described in Articles 3.3 and 3.5 into the Space Station and/or the integrated operation and utilization of the CSA-provided elements;

11. develop, with CSA, the agreed documentation described in Article 7.2;

12. establish, in consultation with CSA and the other partners, information format and communication standards for a technical and management information system, and establish and maintain a computerized technical and management information system. This system is to work in conjunction with a compatible CSA computerized information system in accordance with the principles outlined in documents described in Article 7.2,

13. establish, in consultation with the other partners, verification, safety, and mission assurance requirements and plans in accordance with Article 10;

14. perform ground integration tests as necessary to assure on-orbit compatibility and perform verification and acceptance tests for the flight elements in Article 3.2 and accommodate CSA representation at such tests as necessary for NASA and CSA to fulfill their respective responsibilities under this MOU;

15. ensure that the NASA-provided elements comply with overall Space Station requirements; confirm that CSA-provided elements comply with overall Space Station program requirements; and maintain, and provide to CSA on request, ground verification test procedures and results that are required to verify that the interfaces of the NASA-provided elements and the CSA-provided elements are as set forth in the documents described in Article 7.2;

16. provide necessary ground and flight support equipment and related spares for each NASA-provided flight element; provide the carrier to orbit and other agreed flight support equipment for the CSA-provided flight elements as set forth in the documents described in Article 7.2; and perform qualification and acceptance tests of this equipment according to Space Station program requirements and interfaces as set forth in the documents described in Article 7.2;

17. provide spares for the NASA-provided flight elements as required to support assembly and initial operational verification as set forth in the documents described in Article 7.2 and as agreed to in implementing arrangements;

18. establish Space Station software standards together with CSA and the other partners and, as set forth in the documents described in Article 7.2, develop necessary hardware and software for

software production, develop flight and ground software related to elements it provides in accordance with the established standards, and develop a software integration, test and verification capability for the NASA-provided elements and the Space Station program;

19. develop, in consultation with CSA and the other partners, an architecture for the end-to-end data transmission between data sources on the Space Station and the data users, including real-time user commands;

20. provide a basic operational communications capability between the Space Station Control Center (SSCC) and CSA's Space Operations Support Center to support Space Station operational requirements;

21. establish the SSCC, the Payload Operations Integration Center (POIC) and engineering and user support centers as provided in Articles 3 and 8;

22. develop with CSA, together with the other partners, crew health and medical care policies and procedures in accordance with Article 11;

23. develop an integrated logistics support system for the NASA-provided flight elements; and an integrated logistics management capability for the Space Station Program, including resupply, on-board maintenance and inventory integration, as set forth in the documents described in Article 7.2,

24. establish, with participation of CSA and other partners, integrated traffic plans for the Space Station in accordance with Articles 7, 8, 11 and 12;

25. develop and provide to the System Operations Panel described in Article 8 baseline operations plans, and logistics and maintenance plans for the NASA-provided elements describing routine systems capabilities and defining maintenance requirements, including logistics requirements, necessary for sustaining their functional performance;

26. develop and deliver on orbit the MSS Robotic Work Station based on requirements jointly established with CSA in accordance with the agreed assembly sequence and assist CSA with the integration of the MSS Robotic Work Station with the MSS; and

27. provide for the storage of the CSA-provided flight elements, and associated ground support equipment, prior to their launch.

6 1 b. While undertaking activities related to assembly, operations and utilization of the Space Station, and within the scope of the Parties' responsibilities established elsewhere in this MOU, NASA will:

1. participate in Space Station management mechanisms and development of documentation as provided in Articles 7 and 8, and in the sharing of Space Station operations responsibilities as provided in Article 9;

2. maintain overall systems engineering, integration, risk management and overall operations support capability for Space Station operations and utilization with participation of CSA and the other partners as necessary, and maintain systems engineering, integration, risk management and operations support capability for operations and utilization of the NASA-provided elements;

3. provide, for the NASA-provided elements, sustaining engineering, spares, operations support, training and logistics support;

4. ensure that the NASA-provided elements comply with overall Space Station program requirements; confirm that CSA-provided elements comply with overall Space Station program requirements; and maintain, and provide to CSA on request, on-orbit verification test procedures and results that are required to verify that the interfaces of the NASA-provided elements and the CSA-provided elements are as set forth in the documents described in Article 7.2;

5. maintain Space Station software standards together with CSA and the other partners, maintain necessary hardware and software for software production, maintain flight and ground software related to the elements it provides, and maintain a software integration, test and verification capability for the NASA-provided elements and the Space Station program;

6. provide the basic operational communications capability described in 6.1.a.20;

7. maintain and operate the SSCC, the POIC, and engineering and user support centers as provided in Articles 3 and 8 and support integrated Space Station command and control functions;

8. maintain with CSA, together with the other partners, crew health and medical care policies and procedures and support provision of Space Station crew health in accordance with Article 11;

9. maintain the integrated logistics support system and the integrated logistics management capability described in Article 6 1 a.23;

10. maintain with the other partners, integrated traffic plans for the Space Station in accordance with Articles 7, 8, 11 and 12;

11. deliver on-orbit the CSA-provided flight elements in accordance with Article 12 and the assembly sequence controlled by appropriate program documents as described in Article 7.2; assemble on-orbit Space Station elements, including the flight elements that CSA will provide, with assistance from CSA, in accordance with agreed assembly, activation and verification plans;

12. assist in the on-orbit activation and performance verification of the CSA-provided elements in accordance with agreed assembly, activation and verification plans;

13. provide logistics flights for the NASA-provided elements, for the elements provided by the other partners and for Space Station as a whole, in accordance with Articles 9 and 12;

14. provide or arrange crew rotation in accordance with the documents described in Articles 7, 8 and 9 and implementing arrangements, to support Space Station crew flight opportunities as described in Article 11. Specific assignments of crew members to specific vehicles will be made in accordance with the traffic planning process described in Article 8;

15. provide or arrange for provision of crew rescue capability;

16. arrange with RSA for provision of RSA-generated electrical power and augment RSA-generated electrical power, in accordance with agreed power transfer schedules and provide electrical power to RSA on a contingency basis thereafter, to maintain essential RSA-provided flight element core systems;

17. provide or arrange for provision of reboost and non-propulsive attitude control;

18. deliver or arrange for delivery of on-orbit propellant for reboost and propulsive attitude control;

19. provide the Space Station Training Facility (SSTF) and additional training facilities to accommodate element-specific training for NASA-provided elements and integrated flight crew and ground controller multi-segment training;

20. provide simulators, training materials and documentation for NASA-provided elements for integration into CSA's element-specific training facilities and equipment of CSA-provided elements as set forth in the documents described in Article 7.2;

21. integrate CSA-provided flight software and simulation models, training materials and documentation for CSA-provided elements into NASA training facilities;

22. provide for NASA, CSA, and other partners' crew members and ground support personnel: element-specific training for NASA-provided elements and multi-segment training consistent with the agreed upon overall Space Station training flow and curriculum. The fidelity of this training will be sufficient to ensure the capability to perform all anticipated tasks;

23. support training at the other partners' facilities as agreed, consistent with the agreed upon overall Space Station training flow and curriculum;

24. provide necessary on-orbit storage of spares for the CSA-provided flight elements;

25. provide standard Space Shuttle launch processing and launch and return services for spares for the CSA-provided flight elements as agreed in implementing arrangements;

26. provide repair and overhaul, and follow-on spares for CSA-provided flight elements as set forth in the documents described in Articles 7.2 and 8 and in implementing arrangements;

27. work with CSA and the other partners to prepare and implement plans for the integration and operation of user activities in the Space Station Consolidated Operations and Utilization Plan described in Article 8; and

28. provide user integration support and user operations support in accordance with Article 8.3.

6.2. CSA Responsibilities

6.2.a. While undertaking activities related to the detailed design and development of the Space Station elements described in Articles 3.3 and 3.5.b, and within the scope of the Parties' responsibilities established elsewhere in this MOU, CSA will.

1. support the overall program management and coordination for detailed design and development of an integrated Space Station and manage the detailed design and development of the CSA-provided elements;

2. participate with NASA and the other partners in Space Station program management mechanisms as provided in Articles 7 and 8;

3. support the overall system engineering and integration, which includes integrated risk management activities, and perform system engineering and integration and risk management for the CSA-provided elements, including the end-to-end system engineering and integration of the MSS with the overall Space Station;

4. establish in the U.S. and accommodate in Canada agreed liaison personnel as provided in Article 7.3;

5. provide regular progress and status information on CSA Space Station program activities and plans in accordance with the documents described in Article 7.2;

6. conduct for the elements it provides: technical reviews, including integrated design, critical design, safety and mission assurance and other reviews as set forth in the documents described in Article 7.2; and provide for NASA and other partner participation as necessary for NASA and CSA to fulfill their respective responsibilities under this MOU;

7. participate in, as appropriate, and provide information necessary for ESA, the GOJ or RSA to conduct reviews described in Article 6.1.a.8,

8. participate in, as appropriate, and provide information as necessary for NASA to conduct the reviews identified in Articles 6.1.a.6 and 6.1.a.7;

9. provide to NASA program, system requirements, technical interface, systems design and systems operations information necessary for assessment of the impact of CSA-provided elements on the Space Station configuration and/or on the integrated operation and utilization of the Space Station and necessary to integrate those elements into the Space Station;

10. develop, with NASA, the agreed documentation described in Article 7.2;
11. establish and maintain, in accordance with the principles outlined in the documents described in Article 7.2, a compatible computerized technical and management information system to work in conjunction with the compatible NASA computerized information system referred to in Article 6.1.a.12;
12. establish in consultation with the other partners, verification, safety, and mission assurance requirements and plans in accordance with Article 10;
13. perform ground integration tests as necessary to assure on-orbit compatibility and perform verification and acceptance tests for the flight elements in Article 3.3 and accommodate NASA representation at such tests as necessary for NASA and CSA to fulfill their respective responsibilities under this MOU;
14. ensure that the CSA-provided elements comply with overall Space Station program requirements; and maintain, and provide to NASA on request, ground verification test procedures and results that are required to verify that the interfaces of the NASA-provided elements and the CSA-provided elements are as set forth in the documents described in Article 7;
15. provide necessary ground and agreed flight support equipment and related spares for each CSA-provided flight element and flight spares as set forth in the documents described in Article 7.2; and perform qualification and acceptance tests of this equipment according to Space Station program requirements and interfaces as set forth in the documents described in Article 7 2;
16. provide agreed spares for the CSA-provided flight elements as required to support assembly and initial operational verification as set forth in the documents described in Article 7.2;
17. support the establishment of Space Station software standards in accordance with the documents described in Article 7.2, develop necessary hardware and software for software production, and develop flight and ground software related to elements it provides in accordance with the established standards to work in conjunction with the Space Station program software integration, test and verification capability;
18. support the development, with NASA and the other partners, of an architecture for the end-to-end data transmission between data sources on the Space Station and data users, including real-time user commands;
19. provide, with the exception of the basic operational communications capability provided by NASA as described in Article 6 1 a.20, any additional communications capability necessary for CSA to support CSA's unique requirements;
20. establish in Canada operations and engineering support centers, and the MSS Operations and Training Simulator (MOTS) and training facilities, for the CSA-provided flight elements as provided for in Articles 3 and 8;

21. develop with NASA, together with the other partners, crew health and medical care policies and procedures in accordance with Article 11;

22. develop an integrated logistics support system for the CSA-provided flight elements and support the development of the integrated logistics management capability for the Space Station program, including resupply, on-board maintenance and inventory integration, in accordance with the documents described in Article 7.2;

23. support establishment of integrated traffic plans for the Space Station in accordance with Articles 7, 8, 11 and 12;

24. develop and provide to the System Operations Panel described in Article 8 baseline operations plans, and logistics and maintenance plans for the CSA-provided elements describing routine systems capabilities and defining maintenance requirements, including logistics requirements, necessary for sustaining their functional performance;

25. establish, jointly with NASA, requirements for the NASA-provided Robotic Work Station for the CSA-provided flight elements;

26. deliver the CSA-provided flight elements and associated ground support equipment to a location in the USA, as agreed with NASA, as set forth in the documents described in Article 7; and

27. design elements to be compatible with the Space Shuttle and in accordance with the documents described in Article 7.2.

6.2.b. While undertaking activities related to assembly, operations and utilization of the Space Station, and within the scope of the Parties' responsibilities established elsewhere in this MOU, CSA will:

1. participate in Space Station management mechanisms and development of documentation as provided in Articles 7 and 8, and in the sharing of Space Station operations responsibilities as provided in Article 9;

2. support NASA's overall role described in Article 6 1.b.2, and maintain systems engineering, integration, risk management and operations support capability for operations and utilization of the CSA-provided elements;

3. provide, for the CSA-provided elements, sustaining engineering, operations support, training, logistics support, and spares as set forth in the documents described in Articles 7.2 and 8 and as agreed in implementing arrangements;

4. ensure that the CSA-provided elements comply with overall Space Station program requirements; and maintain, and provide to NASA on request, on-orbit verification test procedures and results that are required to verify that the interfaces of the NASA-provided

elements and the CSA-provided elements are as set forth in the documents described in Article 7.2;

5. support maintenance of Space Station software standards, support maintenance of software integration, test and verification capability for the Space Station program; maintain necessary hardware and software for software production; and maintain flight and ground software related to the elements it provides to work in conjunction with the Space Station program software integration, test and verification capability;

6. provide any additional communications capability as described in 6.2.a.19;

7. maintain and operate the operations and engineering support centers and the MOTS for the CSA-provided flight elements as provided for in Articles 3 and 8;

8. maintain with NASA, together with the other partners, crew health and medical care policies and procedures and support provision of Space Station crew health in accordance with Article 11;

9. maintain the integrated logistics support system described in 6.2.a.22 and support the integrated logistics management capability described in Article 6.1.a.23;

10. support the maintenance of integrated traffic plans for the Space Station in accordance with Articles 7, 8, 11 and 12;

11. assist in the assembly of the CSA-provided elements in accordance with agreed assembly, activation and verification plans;

12. activate on-orbit and verify performance of the CSA-provided elements, with assistance from NASA, in accordance with agreed assembly, activation and verification plans,

13. arrange for logistics flights for the CSA-provided elements in accordance with Articles 9 and 12;

14. support crew rotation in accordance with the documents described in Articles 7, 8 and 9 and implementing arrangements, to support Space Station crew flight opportunities as described in Article 11. Specific assignments of crew members to specific vehicles will be made in accordance with the traffic planning process described in Article 8;

15. maintain and operate training facilities in Canada to accommodate element-specific training for CSA-provided elements;

16. provide flight software and simulation models, training materials and documentation for CSA-provided elements for integration into NASA's training facilities in accordance with the documents described in Article 7.2;

17. integrate NASA-provided simulators, training materials and documentation for NASA-provided elements into the CSA training facilities;

18. provide for NASA, and other partners' crew members and ground support personnel in Canada element-specific training for CSA-provided elements consistent with the agreed upon overall Space Station training flow and curriculum. The fidelity of this training will be sufficient to ensure the capability to perform all anticipated tasks;

19. support training at the other partners' facilities as agreed, consistent with the agreed upon overall Space Station training flow and curriculum, in accordance with documents described in Article 7.2;

20. work with NASA and the other partners to prepare and implement plans for the integration and operation of user activities in the Space Station Consolidated Operations and Utilization Plan described in Article 8; and,

21. provide user integration support and user operations support in accordance with Article 8.3.

Article 7

Management Aspects of the Space Station Program Primarily Related to Detailed Design and Development

7.1. Management/Reviews

7.1.a. NASA and CSA are each responsible for the management of their respective Space Station detailed design and development activities consistent with the provisions of this MOU. This Article establishes the management mechanisms to coordinate the respective Space Station detailed design and development activities of NASA and CSA, to establish applicable requirements, to assure safe operations, to establish the interfaces between the Space Station elements, to review decisions, to establish schedules, to review the status of activities, to report progress and to resolve issues and technical problems as they arise.

7.1.b. The NASA/CSA Program Coordination Committee (PCC), co-chaired by designated NASA and CSA representatives, will meet periodically throughout the lifetime of the program or promptly at the request of either Party to review the Parties' respective detailed design and development activities. The Co-Chairmen will together take those decisions necessary to assure implementation of the cooperative detailed design and development activities related to Space Station flight elements and to Space Station-unique ground elements provided by the Parties, including, as appropriate, activities related to design changes of the Parties' flight elements during mature operations and utilization. In taking decisions regarding detailed design and development, the NASA-CSA PCC will consider operation and utilization impacts, and will also consider detailed design and development recommendations from the Multilateral Coordination Board described in Article 8.1.b. However, decisions regarding operation and utilization activities will be taken in accordance with Article 8. The Co-Chairmen will each designate their

respective members and will decide on the location of meetings. If the Co-Chairmen agree that a specific detailed design and development issue or decision requires consideration by another partner at the PCC level, the NASA/CSA PCC may meet jointly with the NASA/ESA PCC and/or NASA/GOJ PCC and/or the NASA/RSA PCC.

7.1.c. Bilateral/Multilateral Program Reviews will be held as necessary at which the designated representatives of NASA, CSA, and the other partners as appropriate, will report progress and discuss the status of their detailed design and development program activities. The Bilateral Program Reviews will be held as mutually agreed and will be co-chaired by NASA and CSA. The Multilateral Program Reviews will meet as necessary at the request of any partner and will be organized by NASA. Less formal status reviews and technical meetings will be held as necessary; representatives of the partners will attend these reviews and meetings.

7.1.d. Space Station requirements, configuration, including assembly sequence, integrated traffic planning, allocation of housekeeping resources for design purposes, and definition of element interfaces; through the completion of assembly and initial operational verification and any related Space Station configuration activities will be controlled by the Space Station Control Board (SSCB) chaired by NASA. The CSA will be a member of the SSCB, and of such subordinate boards thereof as may be agreed, attending and participating when CSA decides it is appropriate and whenever these boards consider items which affect the CSA-provided elements, interfaces between NASA-provided and CSA-provided elements, interfaces between the CSA-provided elements and the Shuttle, interfaces between the CSA-provided elements and other partner-provided elements, or the accommodation of the Composite Utilization Plan and the Composite Operations Plan described in Article 8. Decisions by the SSCB Chairman may be appealed to the NASA-CSA PCC, although it is the duty of the SSCB Chairman to make every effort to reach consensus with CSA and the other partners rather than have issues referred to the PCC level. Such appeals will be made and processed expeditiously. Pending resolution of appeals, CSA need not proceed with an SSCB decision as far as its provided elements are concerned. NASA may, however, proceed with an SSCB decision as far as its provided elements are concerned. Additional details regarding appeals to the NASA-CSA PCC are contained in the Joint Program Plan described below. NASA will be a member of the CSA Space Station control board (or its equivalent) chaired by CSA, and of such subordinate boards thereof as may be agreed, attending and participating as appropriate

7.1.e. CSA will participate in selected NASA reviews on Space Station requirements, architecture and interfaces as defined in the Joint Management Plan (JMP) described in

Article 7.2.b. These reviews are program level reviews which assure that the Space Station Program is progressing in accordance with relevant program documentation. Similarly, NASA will participate in selected CSA reviews as defined in the JMP; the other partners will participate as appropriate.

7.1.f. Through participation in the management mechanisms, NASA and CSA agree to achieve commonality on the Space Station as required by the overall Space Station safety requirements as defined pursuant to Article 10. NASA and CSA also agree to work through the management mechanisms in order to establish standard interfaces if necessary for Space Station users in the

permanently attached pressurized laboratories. Exceptions to these requirements for commonality may be agreed on a case-by-case basis between NASA and CSA. In addition, NASA and CSA will work through the above management mechanism to seek agreement on a case-by-case basis regarding the use of interchangeable hardware and software in order to promote efficient and effective Space Station operations, including reducing the burden on the Space Station logistics system.

7.2. Program Documentation

7.2.a. A Joint Program Plan for detailed design and development signed by the designated representatives of NASA and CSA will cover the interrelationship between the CSA program and the overall program, the NASA-CSA top-level requirements including schedule, management relationships, NASA-CSA Space Station organizational structures and additional details regarding appeals to the NASA-CSA PCC. Any modification to the JPP will be approved by the PCC.

7.2.b. The Joint Management Plan (JMP) defines the programmatic and technical coordination processes and jointly developed documentation used by NASA and CSA for all Space Station design development and implementation activities. The JMP and all changes to the plan will be jointly signed by the designated representatives of NASA and CSA.

7.2.c. The Concept of Operations and Utilization (COU) document is the source of information which describes how the Space Station operates and is operated. The content of the document will be consistent with the tasks and products produced or prepared by the partners. This document, during the detailed design and development phase of the program, is under the control of the SSCB. However, decisions regarding operation and utilization activities will be taken in accordance with Article 8.

7.2.d. NASA, in conjunction with the other partners, develops an overall Space Station Systems Specification based on information provided by all partners which contains the performance and design requirements for the Space Station flight element and ground facilities hardware and software and provides the technical basis for overall conduct of Space Station detailed design and development activities. The Systems Specification, approved by the SSCB, contains the requirements related to all partners' elements. Any modification to the Systems Specification will be approved by the SSCB. The Systems Specification also includes NASA-CSA joint requirements. This section will be jointly-signed by the designated representatives of NASA and CSA.

7.2.e. NASA and CSA will develop a jointly-signed MSS Segment Specification that meets the requirements of the Systems Specification. CSA will develop element specifications for CSA hardware/software and these specifications will meet the requirements in the jointly signed Segment Specification and the Space Station Systems Specification.

7.2 f. NASA and CSA will jointly develop and sign Interface Control Documents (ICDs) which control interfaces: between the flight elements comprising infrastructural elements and the flight elements comprising accommodations elements as defined in Article 8.1.d; between the flight

elements comprising infrastructural elements; and, as appropriate, between any other flight elements; between flight and ground elements; or among ground elements. Any modifications or any additions to the ICDs will occur through the SSCB-approved process. NASA will also develop a Baseline Configuration Document (BCD), based on information provided by all the partners, which will be the reference document reflecting the configuration of the Space Station.

7.3. Liaison. The NASA Space Station Program Office and the CSA are responsible for NASA/CSA technical liaison activities. In order to facilitate the working relationship between the NASA Space Station Program Office and CSA, CSA will provide, and NASA will accommodate, CSA liaison to the NASA Space Station Program Office. Similarly, NASA will provide and CSA will provide support for accommodation of NASA liaison to the CSA. CSA may also provide additional representation to NASA Headquarters in Washington, D.C., to further facilitate the program working relationships. Arrangements specifying all conditions relating to the liaison relationships will be agreed and jointly-signed by the Co-Chairmen of the NASA-CSA PCC

Article 8

Management Aspects of the Space Station Program Primarily Related to Operations and Utilization

8.1. General

8.1.a. NASA will have the responsibility for the overall management and coordination, through the management mechanisms established in this Article, of the operation of the Space Station, including Earth-to-orbit vehicle access in accordance with Articles 4.1 and 12. NASA and CSA each have responsibilities regarding the management of their respective operations and utilization activities and the overall Space Station operations and utilization activities, in accordance with the provisions of this MOU. Operations and utilization activities will comprise long-range planning and top-level management and coordination, which will be performed by the strategic-level organizations; detailed planning and support to the strategic-level organizations which will be performed by the tactical-level organizations; and implementation of these plans which will be performed by the execution-level organizations.

8.1.b. A Multilateral Coordination Board (MCB) meets periodically over the lifetime of the program or promptly at the request of any partner with the task to ensure coordination of the activities of the partners related to the operation and utilization of the Space Station. The Parties to this MOU and the other partners will plan and coordinate activities affecting the safe, efficient and effective operation and utilization of the Space Station through the MCB, except as otherwise specifically provided in this MOU. The MCB comprises representatives of NASA, RSA, ESA, STA and CSA. The NASA representative will chair the MCB. The Parties agree that all MCB decisions should be made by consensus. Where consensus cannot be achieved on any specific issue within the purview of the MCB within the time required, the Chairman is authorized to take decisions. Nothing in this paragraph shall, however, affect the rights of any partner to use the consultation and settlement of disputes provisions of Article 18. Pending resolution of the issues through consultations, in accordance with the mechanism established in

Article 18, a partner has the right not to proceed with implementation of a decision with respect to its elements. If consensus cannot be achieved on issues not primarily technical or programmatic in nature, including such issues with a political aspect, the consultations and settlement of disputes provisions of Article 18 only will apply. The Parties agree that, in order to protect the interests of all partners in the program, the operation and utilization of the Space Station will be most successful when consensus is reached and when the affected partners' interest are taken into account. MCB decisions will not modify rights of the partners specifically provided in this MOU.

8.1.c. The MCB has established Panels responsible for the long-range strategic coordination of the operation and utilization of the Space Station, including supporting services such as transportation and communications, called the System Operations Panel (SOP) and the User Operations Panel (UOP) respectively, described in detail below. The MCB has developed a SOP-UOP Charter that defines the organizational relationships and responsibilities of these Panels, and the organizational relationships of these Panels with the tactical- and execution-level organizations described below. Any modifications to the SOP-UOP Charter, including consolidation of the panels, will be approved by the MCB. The MCB approves, on an annual basis, a Consolidated Operations and Utilization Plan (COUP) for the Space Station based on the annual Composite Operations Plan (COP) and the annual Composite Utilization Plan (CUP) developed by the Panels and described below. In doing so, the MCB will be responsible for resolving any conflicts between the COP and the CUP which cannot be resolved by the Panels. The SOP and UOP will work together to prepare the COUP as described in the SOP-UOP Charter. The SOP-UOP Charter also delineates the Panels' delegated responsibilities with respect to adjustment of the COUP. The COUP will be implemented by the appropriate tactical- and execution-level organizations. The MCB has also established a Panel for the coordination of crew-related issues, called the Multilateral Crew Operations Panel (MCOP), described in detail in Article 11

8.1.d. Space Station Flight Elements. There are three categories of Space Station flight elements:

- accommodations elements;
- infrastructural elements; and
- other flight elements.

The accommodations elements are the NASA-provided Laboratory Module, the NASA-provided Centrifuge Accommodation Module, the ESA-provided European pressurized laboratory including the accommodations for external payloads, the GOJ-provided JEM including the Exposed Facility and the Experiment Logistics Modules, the RSA-provided Universal Docking Module payload accommodations and the RSA-provided Research Modules (hereinafter the "laboratory modules"); and the RSA-provided accommodation sites for external payloads and the NASA-provided accommodation sites for external payloads. The infrastructural elements comprise Space Station flight elements, including servicing elements such as the Mobile Servicing Center and other elements that produce resources which permit all Space Station flight elements to be operated and used. Other flight elements include the CSA-provided SPDM and

elements used to resupply the Space Station such as orbital transfer vehicles and logistics carriers

8.1.d.1. Housekeeping. Accommodations elements, infrastructural elements, the CSA-provided SPDM and Space Station resources will be used for assembly, for verification and for maintenance of the Space Station in an operational status, and also for the storage of element spares and crew provisions, with secondary storage of crew provisions to be distributed among the laboratory modules. In such use, they are referred to, respectively, as:

- housekeeping accommodations; and
- housekeeping resources.

During Space Station detailed design and development, these housekeeping accommodations and housekeeping resources will be controlled in appropriate program documentation as provided for in Article 7. During Space Station mature operations and utilization, these housekeeping accommodations and housekeeping resources will be controlled according to the mechanisms in Article 8.2.d.

8.1.d.2. Utilization. The accommodations and resources not required to maintain the Space Station in an operational status will be available in connection with Space Station utilization, and are referred to, respectively, as:

- user accommodations; and
- utilization resources.

Details regarding the allocation of the Space Station user accommodations and utilization resources are provided in Article 8.3. NASA, CSA, and the other partners agree to minimize the demands for housekeeping accommodations and housekeeping resources in order to maximize those available for utilization. NASA, CSA and the other partners will work to establish standard interfaces between the elements and the user-provided hardware and software.

8.2. Operations

8.2.a. It is the goal of the Parties to this MOU to operate the Space Station in a manner that is safe, efficient and effective for both Space Station users and Space Station operators. To accomplish this, the MCB has established the SOP to coordinate strategic-level operations activities and operations planning activities as provided for in Article 8.1.c.

8.2.b. The SOP will comprise one member each from NASA, CSA and the other partners. Members may send designated alternates to SOP meetings. In addition, each partner may call upon relevant expertise as necessary to support SOP activities. The SOP will take decisions by consensus; in the event of failure to reach consensus on any issue, the issue will be forwarded to the MCB for resolution. In the interest of efficient management, NASA and CSA recognize that

the SOP should take the responsibility to routinely resolve all operations issues as expeditiously as possible rather than refer such issues to the MCB.

8.2.c. The SOP will develop, approve and maintain an Operations Management Plan (OMP) for the operation, maintenance, and refurbishment of and logistics for the Space Station. This Plan will describe relationships among the strategic, tactical and execution levels of operations management, where the strategic level is coordinated by the SOP; the tactical level, by the tactical operations organization referred to in Article 8.2 e, and the execution level, by implementing organizations and field centers. Consistent with the other provisions of this Article, the OMP will also address operational requirements for the Space Station flight elements and Space Station-unique ground elements. The OMP will provide the procedures for preparation of the baseline operations plans and logistics and maintenance plans provided for in Articles 6.1.a.25 and 6.2.a.24, annual refinements to these baseline plans, and the COP described in Article 8.2.d, including procedures for adjustment of these plans as further information becomes available.

8.2.d. On an annual basis, NASA and CSA will each provide to the SOP any significant refinements to their baseline operations plans and logistics and maintenance plans five years in advance. Using the operations and logistics and maintenance plans and these refinements provided by all of the partners, including requirements for use of Space Station-unique ground elements, the SOP will develop and approve an annual COP consistent with the annual CUP described in Article 8.3.g. The COP will also identify the housekeeping accommodations, housekeeping resources, launch and return transportation services and data transmission capacity required for maintenance of the Space Station in an operational status. Compatibility of the COP and the CUP must be assured through coordination between the SOP and the UOP, described in Article 8.3.e, during the preparation and approval process.

8.2.e. NASA, with the participation of CSA and the other partners, will be responsible for integrated tactical-level activities for Space Station operations. To this end, NASA will establish an integrated tactical operations organization and the other partners will participate in discharging the responsibilities of this organization. The integrated tactical-level activities for the detailed design and development are controlled by the SSCB. NASA, CSA and the other partners will assign experts on the elements each provides to perform integrated tactical operations functions and to participate in overall integrated tactical operations activities. NASA and CSA will consult and agree regarding the procedures for support of integrated tactical activities, the personnel, their location and all administrative conditions related to CSA personnel located in the United States and those related to NASA personnel located in Canada. In conjunction with the integrated activities, NASA, CSA and the other partners will each perform distributed tactical-level activities related to the elements and services each provides, such as decentralized system operations support planning, user support planning, logistics planning, and the accommodations assessments described in Article 8.3.i. Integrated tactical-level activities will include planning for system operations, user support activities across all Space Station elements, Earth-to-orbit vehicle capabilities, data transmission and Earth-to-orbit vehicle operations within the operational control zone. Tactical-level activities for Earth-to-orbit vehicles separated from the Space Station when outside the operational control zone of the Space Station, as defined in the

program documentation provided for in Article 7, will be performed by the Earth-to-orbit vehicle provider.

8.2.f. Multi-Increment Manifests for the Space Station will be developed by the integrated tactical operations organization described in Article 8.2.e to implement the COUP. These manifests will implement launch and return transportation agreements documented in the COUP and include vehicle access, assembly activities, logistics and crew exchange. In addition to the COUP, the Multi-Increment Manifests, Space Station assembly and operational requirements, and payload integration documentation will be used to develop the Increment Definition Requirements Document (IDRD). The IDRD documents increment-specific plans and requirements, is controlled by the integrated tactical operations organization and is baselined two years prior to increment start. For periods up to the completion of assembly and initial operational verification, the IDRD will be controlled by the SSCB, as described in Article 7.1.d. Each IDRD will describe the detailed manifest of user payloads, systems support equipment and supplies needed to support the increment. Each IDRD will also describe changes to the complement of hardware and software to be flown during that increment and the payload and systems support activities needed to carry out the activities approved in the COUP. The IDRD will list the crew complement and define logistics requirements including Earth-to-orbit vehicle interface requirements, changes to housekeeping resource requirements, changes to housekeeping accommodation requirements and communication requirements, including communications systems use and requirements for distribution of data, to support the subject increment. Earth-to-orbit vehicle integration details regarding crew transportation, interface requirements for Station cargo planning, including pressurized and unpressurized carriers, are contained in standard integration documentation as set forth in the documents described in Article 7.2 and defined by the integrated tactical operations organization.

8.2.g.1. NASA, with the participation of CSA and the other partners, will be responsible for integrated execution-level planning for and management of integrated command and control. NASA will coordinate the execution of the overall integrated operation of the Space Station. Performance of integrated execution-level activities for the Space Station as a whole will be implemented by the Space Station Control Center (SSCC) and Mission Control Center-Moscow (MCC-M) within the integrated Space Station command and control concept: integrated command and control of the Space Station during unmanned and manned periods of operation, including crew rescue operations and management of trajectory (ballistics), momentum, altitude and attitude of the Space Station. Each partner will assign experts on the elements that it provides to participate in integrated execution-level activities, and to support real-time on-orbit activities with emphasis on the elements it provides. NASA and CSA will also consult and agree regarding the procedures for support of integrated execution-level activities, the personnel, their location, and administrative conditions related to these personnel. NASA, CSA and the other partners will be responsible for execution of the day-to-day operations in accordance with the integrated planning. The SSCC, established and managed by NASA, will provide integrated command and control of the Space Station and will work in conjunction with the MCC-M, established and managed by RSA, which will also provide command and control functions, including integrated command and control functions for the Space Station as a whole as agreed between NASA and RSA.

8.2.g.2. In addition to supporting the integrated operations as described above for system operations of the elements they provide. NASA will also establish, within the SSCC, its element-unique execution-level operations functions; RSA will also establish, within the MCC-M, its element-unique execution-level operations functions; and the other partners will establish element-unique execution-level operations functions. NASA, CSA and the other partners will consult and agree regarding the element-unique execution-level operations functions to be performed by each partner to work in conjunction with the integrated execution-level functions.

8.2.g.3. The interaction between the element-unique execution-level operations functions and the integrated SSCC and MCC-M functions will be described in the OMP. NASA, CSA and the other partners will provide engineering support to perform detailed engineering assessments and real-time operations support required for the operational control of the Space Station elements they provide. Execution-level activities for Earth-to-orbit vehicles separated from the Space Station flight elements when outside the operational control zone of the Space Station flight elements, as defined in the program documentation provided for in Article 7, will be the responsibility of the Earth-to-orbit vehicle provider. Execution-level activities for vehicles within the operational control zone will be addressed through the integrated execution-level planning activities described above.

8.3. Utilization

8.3.a. NASA, RSA and CSA will provide Space Station infrastructural elements to assemble, maintain, operate and service the Space Station, NASA, RSA, and CSA will also provide resources derived from these infrastructural elements to other partners as provided in

Article 8 3 b Any partner providing user accommodations will retain the use of those accommodations, except for any allocations to other partners, in compensation for their provision of resources, based on those partners' contributions of infrastructural elements and taking into account NASA's role in the overall program management, systems engineering and integration. As applicable, accrued equivalent user accommodation rights are accumulated by each partner first in its own user accommodations. Consequently:

- NASA will retain the use of 97.7% of the user accommodations on its laboratory modules, 97.7% of the use of its accommodation sites for external payloads and will have the use of 46.7% of the user accommodations on the European pressurized laboratory, and 46.7% of the user accommodations on the JEM;
- RSA will retain the use of 100% of the user accommodations on its laboratory modules and the use of 100% on its accommodation sites for external payloads;
- ESA will retain the use of 51% of the user accommodations on its European pressurized laboratory;
- The GOJ will retain the use of 51% of the user accommodations on its JEM; and

- CSA will have the use of the equivalent of 2.3% of the Space Station user accommodations provided by NASA, ESA and the GOJ

Each partner will control the selection of users for its allocation of user accommodations; such control will be exercised in accordance with the procedures in this MOU, in the MOU between NASA and ESA, in the MOU between NASA and the GOJ and in the MOU between NASA and RSA for developing the CUP.

8.3.b. Allocation of Resources

With the exception of crew time, which is allocated as provided in Article 8.3.c, allocation of Space Station resources among the partners will be in accordance with the following approach. RSA will retain 100% of the housekeeping and utilization resources which RSA provides, except as otherwise provided in Article 6. Other than those resources provided to RSA in accordance with Article 6, resources provided by NASA and CSA infrastructural elements will be made available to NASA, the GOJ, ESA and CSA. These resources, excluding those which may be used without allocation as provided in Article 8.3.d, will be allocated as follows: housekeeping resources as noted in Article 8.1.d.1, and required by the elements provided by NASA, the GOJ, ESA and CSA, will be set aside. The remaining resources, which are utilization resources, will be allocated as follows: 76.6% of utilization resources will be allocated to NASA; 12.8% of utilization resources will be allocated to the GOJ; 8.3% of utilization resources will be allocated to ESA; and 2.3% of utilization resources will be allocated to CSA; the above allocation of utilization resources is to the partner, not to the elements, and may be used by the partner on any Space Station element consistent with the COUP. Plans for use of partner allocations of Space Station resources will be developed through integrated planning mechanisms as provided elsewhere in this Article. More than this allocation of any utilization resource may be gained by each partner through barter or purchase from other partners.

8.3.c. Allocation of Crew Time

8.3.c.1. During the period of a three-person crew, crew time required for assembly, verification and maintenance of the Space Station in an operational status will be set aside. Any remaining crew time will be allocated for utilization: 50% of the utilization crew time will be allocated to NASA and 50% to RSA. The above allocations will be adjusted through implementing arrangements as allocations to the other partners for utilization crew time begin. As applicable, specific allocations of utilization crew time to ESA, the GOJ and CSA will be commensurate with utilization resource allocations specified in Article 8.3.b.

8.3.c.2. Following outfitting of the NASA-provided Habitation Module and initial operational verification of the NASA-provided crew rescue vehicle that allows expansion of the crew complement to seven, RSA will have the rights to on-orbit crew time of the equivalent of three crew to perform systems operations for, and utilization activities in or on, its elements. NASA, ESA, the GOJ and CSA will share the rights to on-orbit crew time of the equivalent of four crew to perform systems operations for, and utilization activities in or on, their elements as follows: crew time required for maintenance of the Space Station in an operational status will be set aside; and any remaining crew time will be allocated for utilization. Of this crew time remaining for

utilization, 76.6% will be allocated to NASA, 12.8% to the GOJ; 8.3% to ESA; and 2.3% to CSA.

8.3.c.3. Allocation of crew time to the partners is for the purpose of ensuring equitable distribution of crew time for partner activities. Planning and execution of crew activities will be integrated in accordance with Article 11.6.

8 3 d Space Station Resources, and Transportation and Communication Services

8 3 d 1 Space Station utilization resources are power; user servicing capacity, including services of the CSA-provided SPDM, heat rejection capacity; data handling capacity, crew time; and EVA capacity. The initial list of Space Station utilization resources to be allocated is power, and crew time. All other Space Station utilization resources may be used without allocation. To support the operation and full international utilization of the Space Station as defined in Article 3, NASA, RSA, ESA and the GOJ will provide launch and return transportation services as provided in Article 12.1 and consistent with the integrated traffic planning process. From the total Space Station user payload capacity available on Space Station launch and return transportation flights actually flown each year, each partner will have the right to obtain launch and return transportation services, from any partner providing such services, to support its Space Station utilization plan, commensurate with its allocation of utilization resources, either through its own provision of this capacity or through purchase from any other partner providing such services. NASA, RSA, ESA and the GOJ will correspondingly ensure, through the planning mechanisms established in this Article and Article 12, that all partners can exercise their right to obtain launch and return transportation services to support their Space Station utilization plans. It is anticipated that NASA, RSA, ESA and the GOJ will exercise this right first through provision of their own payload launch and return transportation capacity. (The foregoing does not apply to launch and return transportation capacity provided for the Space Station in connection with Space Station evolutionary additions.) Similarly, the partners will have the right to obtain, commensurate with their allocation of utilization resources, TDRSS data transmission capacity provided by NASA, RSA Data Relay Satellite data transmission capacity, and data transmission capacity provided by other partners as applicable, and available for the Space Station as provided in Article 12.2 and consistent with the COUP. The UOP, defined in Article 8 3 e, will update the lists of utilization resources and allocated utilization resources as necessary as NASA and the other partners gain experience.

8.3.d.2. CSA's allocation of user accommodations and utilization resources may begin once the Space Station Remote Manipulator System is verified following assembly to the Space Station.

8.3.e. It is the goal of the Parties to use the Space Station in a safe, efficient and effective manner. To accomplish this, the MCB has established a UOP, to assure the compatibility of utilization activities of the Space Station. The UOP will comprise one member each from NASA, CSA and the other partners. Members may send designated alternates to UOP meetings. In addition, each partner may call upon relevant expertise as necessary to support UOP activities. The UOP will take decisions by consensus, in the event of failure to reach consensus on any issue, the issue will be forwarded to the MCB for resolution. In the interest of efficient

management, NASA and CSA recognize that the UOP should take the responsibility to routinely resolve all utilization issues as expeditiously as possible rather than refer such issue to the MCB.

8.3.f. The UOP will develop, approve and maintain a Utilization Management Plan (UMP) which will describe relationships among the strategic, tactical and execution levels of utilization management, where the strategic level is coordinated by the UOP; the tactical-level, by the integrated tactical operations organization described in Article 8.2.e; and the execution-level, by implementing organizations and field centers. The UMP will also establish processes for utilization of the Space Station elements, including the user support centers and other Space Station-unique ground elements provided by all the partners, consistent with

Article 8.3.e; define standard user integration support and standard user operations support; and describe the approach to distributed user integration and operations. The UMP will provide procedures for preparation of the partners' Utilization Plans and CUP described in Article 8.3.g, including procedures for adjustment of these Plans as further information becomes available.

8.3.g. Utilization Plan for the Space Station

8.3.g.1. On an annual basis, five years in advance, NASA, CSA and the other partners each will develop a Utilization Plan for all proposed uses of its own allocation of Space Station user accommodations and utilization resources, for the use of their right to obtain launch and return transportation services and data transmission capacity, and for all proposed uses of unallocated Space Station utilization resources and Space Station-unique ground elements. Each partner will satisfy the requirements of its users for storage within the user accommodations available to that partner, with the exception of temporary on-orbit storage in the logistics carriers in which user equipment is launched or returned to Earth as specified in the applicable IDRD. NASA, CSA, and the other partners each will prioritize and propose appropriate schedules for the user activities in its Utilization Plan, including the use of user support centers and other Space Station-unique ground elements to support the utilization of the flight elements. These individual Utilization Plans will take into consideration all factors necessary to assure successful implementation of the user activities, including any relevant information regarding crew skills and special requirements associated with the proposed payloads.

8.3.g.2. NASA and CSA each will forward its Utilization Plan to the UOP. Using the Utilization Plans of NASA, CSA and the other partners, the UOP will develop the CUP, covering the use of both flight and Space Station-unique ground elements, launch and return transportation services and data transmission capacity, based on all relevant factors, including each element-provider's recommendations regarding resolution of technical and operational incompatibilities among the users proposed for its elements. In its use of the Space Station, each partner will seek, through the mechanisms established in this MOU, to avoid causing serious adverse effects on use of the Space Station by the other partners. In the event of failure of the UOP to reach consensus on the utilization of the Space Station flight elements and/or related Space Station-unique ground elements, the issue will be forwarded to the MCB for resolution.

8.3.g.3. Utilization Plans proposed by NASA, CSA and the other partners which fall completely within their respective allocations and do not conflict operationally or technically with one

another's Utilization Plans will be automatically approved. However, Articles 9 3(a), 9 3(b) and 9 6 of the Intergovernmental Agreement will apply

8.3.h. Each partner will participate in integrated tactical-level planning of user activities. To this end, each partner will provide personnel to the operations organization described in

Article 8.2.e. These personnel will participate in integrated tactical-level planning of user activities; they will also support the strategic-level planning of user activities. NASA and CSA will consult and agree regarding the responsibilities to be discharged by the CSA personnel. NASA and CSA will also consult and agree regarding the number of CSA personnel and all administrative conditions related to these personnel.

8.3.i. A partner providing accommodations elements will be responsible for providing standard user integration support and standard user operations support for use of its accommodations elements by users of the other partners or the other partners as users. In the case of such use, the partner sponsoring the user will be responsible for performing integration of its payload on the ground. Such integration will be to appropriate standard interface levels as agreed among the affected partners. Accommodations assessments for the integrated payload complements manifested in an accommodation element covering engineering, operations and software compatibility will also be performed by the partner providing that accommodation element in support of the preparation and execution of the IDRDs. Similarly, CSA will be responsible for providing standard user integration support and standard user operations support for users of the other partners or other partners as users of the flight elements provided by CSA. As required, NASA or RSA will be responsible for providing standard user integration support and standard user operations support for users of the other partners or other partners as users of the Space Station systems/subsystems each provides.

8.3.j. NASA, ESA, the GOJ and CSA will participate in discharging the responsibilities of the Payload Operations Integration Center (POIC) established and managed by NASA which will be responsible for the following integrated functions for the Space Station as a whole: overall integration of the planning of user activities on the Space Station, overall management and coordination of the execution of user activities on the Space Station, and interaction with the SSCC in order to coordinate user activities with systems operations activities. NASA will also establish, within the POIC, its element-unique payload operations integration functions. Each of these partners will provide personnel to the POIC. These personnel will bring expertise on the accommodations elements and payloads that partner provides, will participate in integrated POIC-based activities and will support real time on-orbit activities with emphasis on the accommodations elements and payloads each provides. NASA and CSA will consult and agree regarding the responsibilities to be discharged by the CSA personnel. NASA and CSA will also consult and agree regarding the number of CSA personnel and all administrative conditions related to these personnel. The partners may also participate in and provide personnel to other execution-level utilization activities at other sites as agreed. RSA will participate in the above activities as agreed in implementing arrangements. For operations integration of all payloads in each of the accommodation elements they provide, NASA, RSA, ESA and the GOJ will establish element-unique payload operations integration functions to work in accordance with the IDRD and in coordination with the POIC, as provided above. The interaction between the integrated

functions of the POIC, and the SSCC will be documented in the OMP. NASA, RSA, ESA and the GOJ will also provide user support centers to assist Space Station users in planning and executing user activities on the Space Station. The interaction between the element-unique payload operations integration functions, the user support functions, and the integrated functions of the POIC will be described in the UMP.

8.3.k. In working out problems which may arise after the development of the COUP, in the case of a technical or operational incompatibility between users, the partner(s) providing the element(s) in which the users have accommodations, as well as other impacted partners, will provide appropriate analyses and recommendations to the appropriate strategic-, tactical- or execution-level organization for resolution of conflicts. However, if such conflict only has impacts within a single Space Station element and only impacts users of the provider of that element, the partner providing that element will be responsible for resolving such conflicts in accordance with the content of the COUP.

8.3.l. NASA, CSA and the other partners may at any time barter for, sell to one another or enter into other arrangements for any portion of their Space Station allocations, and are free to market the use of their allocations individually or collectively, according to the procedures established in the UMP. The terms and conditions of any barter or sale will be determined on a case-by-case basis by the parties to the transaction. The partner providing allocations will ensure that the obligations it has undertaken under this MOU are met. NASA, CSA and the other partners each may retain the revenues they derive from such marketing.

8.3.m. NASA and CSA will make their Space Station-unique ground elements, including user support centers, available for use by each other and the other partners in order to support fully both the standard and special user integration and operations support approved in the CUP and the requirements in the COP. Any special user integration support or user operations support provided by a partner to users of the other partners or other partners as users will be provided on a reimbursable basis at prices routinely charged comparable users for similar services.

8.4. In order to protect the intellectual property of Space Station users, procedures covering all personnel, including Space Station crew, who have access to data are developed by the MCB.

8.5. The partners will seek to outfit the laboratory modules to equivalent levels by the end of Space Station detailed design and development.

Article 9

Responsibilities for Operations Costs and Activities

9.1. The Parties, and the other partners under the relevant MOUs, will seek to minimize operations costs for the Space Station. The Parties, and the other partners under the relevant MOUs, will also seek to minimize the exchange of funds, for example, through the performance of specific operations activities.

9.2. Element Operations Costs and Activities

9.2.a. NASA and CSA will each have operational responsibilities for the elements it provides as detailed in Articles 6 and 8 and in implementing arrangements. Such operational responsibilities mean that NASA and CSA will each be responsible for element operations costs or activities, that is, costs or activities attributed to operating and to sustaining the functional performance of the flight elements that it provides, such as ground-based maintenance, sustaining engineering, provision of spares, launch and return of spares, launch and return of the fraction of the logistics carriers provided for in Article 3 that is attributable to spares, and also costs or activities attributed to the maintenance and operation of element-unique ground centers.

9.3. Common System Operations Costs and Activities

9.3.a NASA, CSA and the other partners will equitably share responsibilities for the common system operations costs or activities: that is, costs or activities attributed to the operation of the Space Station as a whole. Common system operations costs and activities will not include the element operations costs and activities described in Article 9.2 nor the user operations costs and activities described in Article 9.6. RSA will be responsible for the share of the common system operations costs or activities corresponding to the support of the operation of the elements it provides. NASA, ESA, the GOJ and CSA collectively will be responsible for the share of the common system operations costs or activities corresponding to the support of the operation of elements they collectively provide using the following approach: each will be responsible for a percentage of these common system operations costs or activities equal to the percentage of Space Station utilization resources allocated to them in Article 8.3.b. The categories comprising common system operations are: integrated tactical planning activities performed by the integrated tactical operations organization provided for in Article 8.2.e, including user integration planning and maintenance of common documentation; space systems operations (operations and maintenance of integrated SSCC and MCC-M functions, and common elements of software integration, test and verification capability); operations and maintenance of integrated POIC functions; integrated logistics management including resupply, onboard maintenance and inventory integration; prelaunch/postlanding processing of logistics carriers, and launch to orbit and return of consumables, crew and crew logistics, and launch and return of the fraction of the logistics carriers provided for in Article 3 that is attributable to consumables and crew logistics. Any changes to the list of categories comprising common system operations in this Article will be made by the SOP. CSA's sharing of common system operations responsibilities will begin when CSA begins to utilize the Space Station in accordance with Article 8.3.d.2.

9.3.b CSA will perform common system operations activities for the benefit of NASA and the other partners, and NASA will perform, or arrange for other partners to perform common system operations activities for the benefit of CSA and the other partners in accordance with Articles 6 and 8. Compensation for performance of these activities is as agreed in implementing arrangements. NASA, ESA, the GOJ and RSA will perform common system operations activities as specified in the MOU between NASA and ESA, the MOU between NASA and the GOJ and the MOU between NASA and RSA.

9 3 c. In accordance with the MOU between NASA and RSA, full satisfaction of the RSA share of common system operations responsibilities, through performance of common system operations and other activities, is as agreed in implementing arrangements. In addition to RSA's activities referred to above, RSA will perform common system operations contributing to the support of the operation of elements NASA, ESA, the GOJ and CSA collectively provide. NASA, ESA, the GOJ and CSA will work together, in accordance with Article 9.4, to identify and quantify such activities and to account for them in the contents of the common system operations activities and costs.

9.4. The SOP will develop detailed procedures for the implementation of this Article, including to identify the detailed contents to be included in each category comprising common system operations and to estimate, based on agreed assumptions, a not-to-exceed figure for common system operations activities and costs to be approved by the MCB. The partners will also, each year, report to the SOP on their forecasts for future years for the common system operations activities and costs and on their identified actual annual common system activities and operations costs. The SOP, in consultation with the UOP, will work to contain the common system operations activities and costs within the estimated not-to-exceed figure approved by the MCB and to this end will recommend to the MCB corrective measures in the COUP whenever it appears that the annual forecasted costs may exceed this figure. In such cases, the MCB will either approve the SOP's recommendations or take other measures, including reevaluation and adjustment of the not-to-exceed figure. If possible, after the partners have gained experience in the operation of the Space Station, the SOP will endeavor to establish fixed values for the annual common system operations activities and costs. RSA will participate in the process as appropriate.

9.5. Offsets

9 5.a Any partner may, as agreed with NASA, in consultation with the other partners, perform common system operations or other activities to offset its responsibility for common system operations costs. NASA will establish with this partner, and any affected partners, implementing arrangements on the contents and scope of the common system operations activities and on any other activities to be performed by this partner to offset its responsibility for common system operations costs.

9 5 b Offset of the CSA share of common system operations costs, through a provision of goods and services, and the performance of common system operations and other activities, including the provision of CSA personnel as provided for in Articles 8 2 e, 8.2.g, 8.3.h, and 8 3 i, are as agreed in implementing arrangements between CSA and NASA.

9.6. Costs of User Activities

9 6 a. Costs of user activities such as payload/experiment design, development, test and evaluation (DDT&E), payload ground processing; provision of payload/experiment spares and associated equipment; transmission and handling of user data; launch and return of payloads/experiments, spares and associated equipment; launch and return of the fraction of the logistics carriers provided for in Article 3 that is attributable to user payloads/experiments, spares

and associated equipment; and any special user integration or user operations support, including specialized crew training, will be the responsibility of Space Station users of the partners or of individual partners as users. Such costs will not be shared among NASA, CSA and the other partners. In addition, the DDT&E and operations costs of the users' support centers will not be shared among NASA, CSA and the other partners.

9.7. NASA, CSA and the other partners will not recoup their DDT&E costs for their elements from one another in the operation and utilization of the Space Station.

9.8. In case of failure of any partner to perform its operations responsibilities or to provide for its share of common system operations costs, as provided in Article 9.2, or to provide for its share of common system operations responsibilities, as provided for in Article 9.5, the partners will meet to discuss what action should be taken. Such action could result in, for example, an appropriate reduction of the failing partner's rights to its allocations

Article 10

Safety and Mission Assurance

10.1. In order to assure safety, NASA has the responsibility, working with CSA and the other partners, to establish overall Space Station safety and mission assurance requirements and plans covering Space Station detailed design and development activities and mature operations and utilization. Development of further safety and mission assurance requirements and plans and changes to safety and mission assurance requirements and plans will be processed according to the procedures in Articles 7 and 8

10.2. Each partner will develop detailed safety and mission assurance requirements and plans, using its own requirements, for its Space Station hardware and software. Such requirements and plans must meet or exceed the overall Space Station safety and mission assurance requirements and plans established by NASA working with CSA and the other partners. Each partner will have the responsibility to implement applicable overall and detailed Space Station safety and mission assurance requirements and plans throughout the lifetime of the program, and to certify that such requirements and plans have been met with respect to the Space Station elements and payloads it provides. NASA will have the overall responsibility to certify that the Space Station as a whole and its elements and payloads are safe

10.3. NASA will conduct overall integrated system safety reviews for Space Station elements, launch package stage and payloads which CSA will support. NASA, CSA and the other partners will also conduct safety reviews of the elements and payloads they provide; NASA will participate in and support such reviews by the other partners. Each partner will also participate in and support safety reviews by the other partners as appropriate related to the elements and payloads that partner provides. Partner support to such safety reviews will include the provision of necessary safety-related information to enable the other partners to conduct their reviews. The partners will participate as appropriate in any Space Station safety review boards managed by NASA.

10 4 NASA, CSA and the other partners will establish contingency procedures for on-orbit emergencies to protect the safety of the Space Station and its crew. NASA, CSA and the other partners will also establish a process for consultations in the event of on-orbit emergencies for which contingency procedures do not exist. If this consultation process cannot be followed within the time required, due to the nature of the emergency, or if consensus cannot be reached within the time required, NASA will have the responsibility for making decisions necessary to protect the safety of the Space Station and its crew, following procedures agreed in advance for implementation of such decisions.

Article 11

Space Station Crew

11.1. Each partner has the right to provide personnel to serve as Space Station crew from the time the partner begins to share common system operations responsibilities. During the period of a three-person crew, NASA and RSA will be allocated 50% of the three crew flight opportunities. The above allocations will be adjusted as allocations to the other partners for crew flight opportunities begin, commensurate with utilization resource allocations specified in Article 8.3.b, while maintaining equal shares for NASA and RSA. During assembly, flight opportunities for NASA and RSA Space Station crew will be satisfied over time and not necessarily on each specific crew rotation cycle; however, in the event of adjustments, each crew complement will have at least one representative from NASA and one from RSA. Following outfitting of the NASA-provided Habitation Module and initial operational verification of the NASA-provided crew rescue vehicle, when the Space Station has a crew of seven, RSA will be allocated three crew flight opportunities. The remaining four crew flight opportunities will be allocated to NASA, ESA, the GOJ and CSA commensurate with utilization resources allocations specified in Article 8 3.b and will be satisfied over time, not necessarily on each specific crew rotation cycle. The SOP will annually, or as required by any partner, review the implementation of this paragraph and provide its conclusions to the MCB.

11 2 During Space Station assembly and verification, fully trained CSA crew members will participate in on-orbit assembly and system verification of the CSA-provided flight elements and other assigned flight element assembly and system verification tasks planned during that on-orbit period as provided in the verification plan described in Article 6, and utilization activities as provided for in Article 8.

11.3. The MCB will establish a Multilateral Crew Operations Panel (MCOP) which will be the primary forum for the top-level coordination and resolution of Space Station crew matters which affect all partners including the processes, standards and criteria for selection, certification, assignment and training of Space Station crew. The MCB will develop an MCOP Charter that defines the specific responsibilities of this Panel. Any modifications to this Charter will be approved by the MCB. The MCOP will have a rotating chairmanship and all decisions taken will be by consensus. The partners will propose to the MCOP their candidates for Space Station crew based on mission requirements and allocated flight opportunities. If the MCOP determines the candidates meet the Space Station crew standards and criteria, the candidates will be assigned to specific crew complements, subject to approval in accordance with the partners' internal agency

procedures. Following assignment to a crew, the entire crew will begin increment-specific training in order to acquire skills necessary to conduct Space Station operations and utilization. One or more specific crew complements, can be trained as a team in preparation for a specific crew rotation cycle according to the agreed curriculum and specific mission requirements. The MCOP will determine the readiness of the crew for flight based on the results of a review of the crew's medical condition and the crew's performance during training.

11.4. NASA, CSA and the other partners will establish a Multilateral Medical Policy Board (MMPB) to provide coordination and oversight of crew health issues. NASA and CSA will each provide a single point of contact for medical support who will have full responsibility to resolve issues related to the development of a common system for medical support. The MMPB will be supported by a Multilateral Space Medicine Board (MSMB) and by a Multilateral Medical Operations Panel (MMOP), established by NASA and CSA with the other partners, which will be the primary working level groups for coordination of crew health matters including clinical care, medical standards, preventative medicine (including operational countermeasures) and environmental monitoring. The MMOP and the MSMB will operate on the principle of consensus. The MMOP will develop medical standards, certification criteria, pre-flight, in-flight, and post-flight medical care requirements, medical hardware responsibilities and operational procedures and recommend them to the MSMB for approval. The MSMB will present its decisions and findings to the MMPB and MCOP, as appropriate, for review and concurrence. NASA, CSA, and the other partners will be responsible for medical certification of their respective crew member in accordance with agreed standards, and will present the appropriate documentation to the MSMB for approval. The MSMB will have responsibility for final medical certification of crew and for oversight of the implementation of medical operations.

11.5. NASA, CSA and the other partners will establish a Human Research Multilateral Review Board (HRMRB). This Board will have the responsibility for assuring that human research protocols do not endanger the health, safety, and well-being of human research subjects on the Space Station, while ensuring ethical conduct of experiment operations. The HRMRB will review and approve, prior to their implementation, human research protocols for the Space Station proposed by the partners. The HRMRB will operate on the principle of consensus.

11.6. The Space Station crew will operate as one integrated team with one Commander. Consistent with the principle of an integrated crew, the entire crew will operate under a single timeline for performance of all operations and utilization activities. The crew Commander will be responsible for the mission program implementation and crew safety assurance aboard the Space Station. Specific details concerning this integrated crew concept will be agreed by the MCOP.

11.7. NASA will be financially responsible for all compensation, medical expenses, subsistence costs on Earth, and training for Space Station crew which it provides. CSA will be financially responsible for all compensation, medical expenses, subsistence costs on Earth, and training for Space Station crew which it provides. NASA and CSA each agree to waive fees for Space Station-related training for the other's Space Station crew. Specifically, CSA will not be charged Space Station-related training costs for its Space Station crew training at NASA or NASA contractor facilities, and NASA will not be charged Space Station-related training costs for its

Space Station crew training in CSA or CSA contractor facilities. This waiver of fees will also apply to any Space Station-related crew training at NASA or NASA contractor facilities or at CSA or CSA contractor facilities for all other partners' Space Station crew. Space Station-related crew training will be defined by the MCOP. Such training includes instruction, training materials and equipment, access to all necessary facilities (including travel among NASA and NASA contractor facilities and travel among CSA and CSA contractor facilities) and all costs for activities in the agreed Space Station training plan and curriculum that will be used for training following certification of Space Station crew pursuant to Article 11.3. Agreed training for all assigned duties will be required.

11.8. The Space Station Code of Conduct will be developed by the partners and submitted to the MCB for approval. Each partner must have approved the Space Station Code of Conduct before it provides Space Station Crew. The Space Station Code of Conduct will, inter alia, establish a clear chain of command on-orbit, clear relationship between ground and on-orbit management; and management hierarchy; set forth standards for work and activities in space, and, as appropriate, on the ground; establish responsibilities with respect to elements and equipment; set forth disciplinary regulations; establish physical and information security guidelines; and provide the Space Station Commander appropriate authority and responsibility, on behalf of all the partners, to enforce safety procedures, physical and information security procedures and crew rescue procedures for the Space Station.

Article 12

Transportation, Communications and Other Non-Space Station Facilities

12.1. Transportation

12.1.a. Launch and return transportation services for the Space Station will be provided by the following government and private sector space transportation systems:

- the US Space Shuttle;
- the Russian Proton, and Soyuz launch vehicle and the Progress M and Soyuz TM;
- the European Ariane-5 launch vehicle and the associated orbital transfer vehicle; and
- the Japanese H-II launch vehicle and the associated orbital transfer vehicle.

12.1.b. The partners will also have the right of access to the Space Station for launch and return transportation services using other government or private sector space transportation systems of the partners. Potential future partner space transportation systems include:

- the European vehicle for crew and cargo delivery and return; and

- the Japanese Space Transportation System for Space Station launch and return transportation services.

12.1.c. Recognizing that the responsibility for developing space transportation systems and for making them technically and operationally compatible with Space Station rests with the providing partner, the appropriate partners will exchange information necessary to support such compatibility. Technical, operational and safety requirements for access to the Space Station will be controlled in appropriate program documentation as provided for in Articles 7 and 8.

12.1.d. Provision of launch and return transportation services to the Space Station will be in accordance with the integrated traffic planning, management mechanisms, and documentation provided for in Articles 7 and 8 and in accordance with Article 9. NASA and the other partners providing Space Station launch and return transportation services will each develop a partner transportation model, for their transportation systems. The partners' transportation models will be combined into a single integrated launch and return transportation model for the Space Station program. This integrated launch and return transportation capability to be provided by the partners providing launch and return transportation services will be the basis for the integrated traffic planning process supporting development of the COUP, which will specify launch and return vehicles, their capabilities, allocation of launch and return transportation services to the partners and the relevant schedules.

12.1.e Except as otherwise agreed, each partner provides or arranges with other partners on a reimbursable basis for the provision of launch and return transportation services for the flight elements it provides including assembly and logistics requirements. With regard to utilization activities, each partner provides or arranges with other partners on a reimbursable basis for the provision of launch and return transportation services in connection with its Space Station users. The right to obtain launch and return transportation services for Space Station utilization activities is as provided in Article 8.3.d. Reimbursement for such services may be in cash, or agreed kind. All reimbursable transportation services will be provided under launch services agreements

12.1.f NASA will provide reimbursable Space Shuttle launch and return transportation services to ESA in connection with the assembly of the ESA-provided European pressurized laboratory to the Space Station and its initial outfitting in accordance with the program documentation described in Article 7.2.

12.1.g NASA will provide reimbursable Space Shuttle launch and return transportation services to the GOJ in connection with the assembly of the GOJ-provided JEM to the Space Station and its initial outfitting in accordance with the program documentation described in Article 7.2.

12.1.h NASA will be responsible for standard Space Shuttle launch and return transportation services in connection with the assembly of the CSA-provided flight elements to the Space Station (CSA will be responsible for any optional Space Shuttle launch services required in connection with the assembly of the CSA-provided flight elements to the Space Station).

12.1.i. Partners which provide launch and return transportation services in connection with Space Station common system operations will do so in accordance with Article 9.

12.1.j. Each partner will use its best efforts to accommodate additional launch and return transportation service requirements in relation to the Space Station, as well as proposed requirements and flight schedule related to the Space Station activities described above.

12.1.k. Each partner will respect the proprietary rights in and confidentiality of appropriately marked data and goods to be transported on its launch and return transportation system.

12.2. Communications

Space Station communications will involve space-to-ground, ground-to-space, ground-to-ground and space-to-space data transmission.

12.2.a. NASA will provide the TDRSS space and ground communications network for command, control and operations of Space Station elements and payloads, as provided for in Article 8.2.g, and other Space Station communications purposes.

12.2.b. RSA will provide the RSA Data Relay Satellite system space and ground network for command, control and operations of Space Station elements and payloads, as provided for in Article 8.2.g, and other Space Station communications purposes.

12.2.c. ESA may provide the EDRS space and ground network for complementary communications support for command, control and operations of the European pressurized laboratory and payloads, and other Space Station communications purposes.

12.2.d. The GOJ may provide the GOJ data relay satellite system space and ground network for complementary communications support for command, control and operations of the JEM and payloads and other Space Station communications purposes.

12.2.e. Recognizing that the responsibility for developing the above systems and for making them technically and operationally compatible with the Space Station and with Space Station use of TDRSS and of the RSA Data Relay Satellite system rests with the providing partner, NASA or RSA will provide information necessary to support such compatibility. Other communications systems may be used on the Space Station by the partners or Space Station users if such communications systems are compatible with the Space Station and with the Space Station use of TDRSS and the RSA Data Relay Satellite system. Technical, operational and security requirements related to Space Station communications will be controlled by appropriate program management mechanisms and in documentation as provided for in Articles 7 and 8. Unless otherwise agreed with NASA or NASA and RSA, end-to-end transmission of data throughout the Space Station communications system will be compatible with the communications transportation formats, protocols and standards agreed to by the Consultative Committee for Space Data Systems (CCSDS).

12.2.f. Provision of Space Station communications will be documented in the COUP and in accordance with the management mechanisms and other documentation provided for in Articles 7 and 8

12.2.g. With regard to utilization activities, each partner provides or arranges with other partners on a reimbursable basis for the provision of communications services in connection with its Space Station users. Reimbursement for such services may be in cash, or agreed kind. All reimbursable communications services will be provided under communications services agreements. The right to purchase TDRSS or RSA Data Relay Satellite system data transmission capacity for Space Station utilization activities is as provided in Article 8.3.d. The partners will use their best efforts to accommodate, with their respective communications systems, each other's specific Space Station-related requirements

12.2.h Partners and users of the partners may implement measures to ensure confidentiality of their utilization and housekeeping data passing through communications systems being used in connection with the Space Station. (Notwithstanding the foregoing, data which are necessary to assure safe operations will be made available according to procedures in the Operation Management Plan and the Utilization Management Plan and their use will be restricted to safety purposes only.) Each partner will respect the proprietary rights in, and the confidentiality of, the utilization and housekeeping data passing through its communications systems, including its ground network and the communications systems of its contractors, when providing communication services to another partner. Each partner will respect the confidentiality of personnel and medical data passing through its communications systems, including its ground network and the communications systems of its contractors, when providing communications services to another partner.

12.2.i. The partners will each assure that their Space Station information resources, such as computer systems and data transmission systems, are provided a level of security and integrity consistent with potential harm from their loss, inaccuracy, alteration, unavailability, or misuse. The level of security and integrity referred to above is defined through the management mechanisms and controlled in the documentation provided for in Articles 7 and 8.

12.3. Other Non-Space Station Facilities

12.3 a. Should CSA desire to use the Space Shuttle or other NASA facilities on a cooperative or reimbursable basis to support the development of its Space Station Utilization Plan or to support its Space Station detailed design or development activities, NASA will use its best efforts to accommodate CSA's proposed requirements and schedules. Likewise, should NASA desire to use CSA facilities on a cooperative or reimbursable basis to support the development of its Space Station Utilization Plan or to support its Space Station detailed design or development activities, CSA will use its best efforts to accommodate NASA's proposed requirements and schedules.

12.3.b. If NASA and CSA agree that it is appropriate and necessary for the conduct of the cooperative program, NASA and CSA will use their good offices in connection with attempting to arrange for the use of U.S. and Canadian Governments' or contractors' facilities by the Parties

and/or their contractors. Such use will be subject to separate arrangements between the user and the owner of the facilities.

Article 13

Advanced Development Program

13.1. NASA and CSA each are conducting Space Station advanced development programs in support of their respective detailed design and development activities. Cooperation in such advanced development activities will be considered on a case-by-case basis and entered into where it is advantageous to both sides and where there are reciprocal opportunities.

13.2. CSA proposals to use NASA advanced development testbeds or other NASA facilities in support of CSA's Space Station advanced development program will be considered on a case-by-case basis either on a cooperative or reimbursable basis. Likewise, NASA proposals to use CSA's facilities in support of NASA's Space Station advanced development program will be considered on a case-by-case basis either on a cooperative or reimbursable basis.

13.3. Should CSA desire to use the Space Shuttle on a cooperative or reimbursable basis to support CSA Space Station advanced development activities, NASA will use its best efforts to accommodate CSA's proposed requirements and flight schedules.

Article 14

Space Station Evolution

14.1. NASA, CSA and the other partners intend that the Space Station will evolve through the addition of capability and will strive to maximize the likelihood that such evolution will be effected through contributions from all the partners. To this end, it will be the object of the Parties to provide, where appropriate, the opportunity to the other partners to cooperate in their respective proposals for additions of evolutionary capability. The Space Station together with its additions of evolutionary capability will remain a civil station, and its operations and utilization will be for peaceful purposes, in accordance with international law.

14.2. This MOU sets forth rights and obligations concerning only the elements listed in Article 3, except that this Article and Article 16 of the Intergovernmental Agreement will apply to any additions of evolutionary capability. As such, this MOU does not commit either Party to participate in, or grant either Party rights in, the addition of evolutionary capability.

14.3. NASA and CSA agree to study evolution concepts for the Space Station during detailed design and development and mature operations and utilization. NASA will be responsible for development of overall Space Station evolution concepts, in consultation with CSA and the other partners, and for integrating CSA's and the other partners' evolution concepts into an overall Space Station evolution plan.

14.4. NASA, CSA, and the other partners will participate in an International Evolution Working Group (IEWG) to coordinate their respective evolution studies and to consider overall Space Station evolution concepts and planning activities.

14.5. The MCB will review specific evolutionary capabilities proposed by any partner, assess the impacts of those plans on the other partners' elements and on the Space Station, and review recommendations for minimizing potential impacts on Space Station activity during the addition of evolutionary capabilities.

14.6. Following the review and assessment provided for in Article 14.5, and consistent with the provisions of the Intergovernmental Agreement, cooperation between or among partners regarding the sharing of addition(s) of evolutionary capability will require, either the amendment of the MOU between NASA and CSA, the MOU between NASA and the GOJ, the MOU between NASA and ESA and/or the MOU between NASA and RSA, or a separate agreement to which NASA, to ensure that any addition is consistent with the overall program, and with any other partner providing a Space Station element or space transportation system on which there is an operational or technical impact, will be a party.

14.7. Following the review and assessment provided for in Article 14.5, and consistent with the provisions of the Intergovernmental Agreement, the addition of evolutionary capability by one partner will require prior notification of the other partners and an agreement with NASA, to ensure that any addition is consistent with the overall program, and with any other partner providing a Space Station element or space transportation system on which there is an operational or technical impact.

14.8. The addition of evolutionary capability will in no event alter the rights and obligations of either Party to this MOU concerning the elements listed in Article 3, unless otherwise agreed by the affected Party.

Article 15

Cross-Waiver of Liability; Exchange of Data and Goods;
Treatment of Data and Goods in Transit;
Customs and Immigration;
Intellectual Property; Criminal Jurisdiction

The Parties note that, with respect to the cross-waiver of liability, exchange of data and goods, treatment of data and goods in transit, customs and immigration, intellectual property and criminal jurisdiction, the relevant provisions of the Intergovernmental Agreement apply

Article 16

Financial Arrangements

16.1. Each Party will bear the costs of fulfilling its responsibilities, including but not limited to costs of compensation, travel and subsistence of its own personnel and transportation of all

equipment and other items for which it is responsible under this MOU. However, as provided in Article 9 the partners will equitably share common system operations responsibilities.

16.2 The ability of each Party to carry out its obligations is subject to its funding procedures and the availability of appropriated funds.

16.3. In the event that funding problems arise that may affect a partner's ability to fulfill its responsibilities under this MOU, that partner will promptly notify and consult with the other partners. Further, the Parties undertake to grant high priority to their Space Station programs in developing their budgetary plans.

16.4. The Parties will seek to minimize the exchange of funds while carrying out their respective responsibilities in this cooperative program, including, if they agree, through the use of barter, that is, the provision of goods or services.

Article 17

Public Information

17.1. NASA and CSA will be responsible for the development of an agreed Public Affairs Plan that will specify guidelines for NASA-CSA cooperative public affairs activities during the detailed design, development, operation and utilization of the Space Station.

17.2. Within the Public Affairs Plan guidelines, both NASA and CSA will retain the right to release public information on their respective portions of the program. NASA and CSA will undertake to coordinate with each other, and, as appropriate, with the other partners, in advance concerning public information activities which relate to each other's responsibilities or performance in the Space Station program

Article 18

Consultation and Settlement of Disputes

18.1. The Parties agree to consult with each other and with the other partners promptly when events occur or matters arise which may occasion a question of interpretation or implementation of the terms of this MOU.

18.2. In the case of a question of interpretation or implementation of the terms of this MOU, such question will be first referred for settlement to the appropriate officials designated, respectively, by the NASA Administrator and the President of the CSA. The Parties recognize that in the case of a question which requires consideration by another partner, the consultations will be broadened so as to include appropriate officials designated, respectively, by the ESA Director General, the Minister of State for Science and Technology of Japan, and/or the RSA General Director.

18.3. Any question of interpretation or implementation of the terms of this MOU which has not been settled in accordance with Article 18.2 will be referred for settlement to the NASA Administrator and the President of CSA. The Parties recognize that in case of a question which requires consideration by another partner the matter will also be referred to the Director General of ESA, the Minister of State for Science and Technology of Japan and/or the RSA General Director.

18.4 Any issues arising out of this MOU not satisfactorily settled through consultation pursuant to this Article may be pursued in accordance with Article 23 of the Intergovernmental Agreement.

18.5. Unless otherwise agreed between NASA and CSA, implementation of decisions made pursuant to mechanisms provided for in this MOU will not be held in abeyance pending settlement of issues under this Article, except as provided in Articles 7.1.d and 8.1.b.

Article 19

Entry into Force; Withdrawal

19.1. Pursuant to the Arrangement Concerning Application of the Intergovernmental Agreement Pending its Entry Into Force, which became effective on January 29, 1998, this MOU will become effective after signature of both the NASA Administrator or his designee and the President of CSA or his designee, upon written notification by the governments to each other that all procedures necessary for its entry into force have been completed.

19.2. Pending the entry into force of the Intergovernmental Agreement for the Government of the United States and the Government of Canada in accordance with Article 25 of the Intergovernmental Agreement, the Parties agree, to the fullest extent possible consistent with their domestic laws and regulations, to abide by the relevant terms of the Intergovernmental Agreement.

19.3 If the United States or Canada withdraws from the Arrangement Concerning Application of the Intergovernmental Agreement Pending its Entry into Force, the corresponding Cooperating Agency will be deemed to have withdrawn from this MOU effective from the same date.

19.4 If the United States or Canada gives notice of withdrawal from the Intergovernmental Agreement in accordance with Article 28 of that Agreement, the corresponding Cooperating Agency will be deemed to have withdrawn from this MOU effective from the date of such withdrawal.

Article 20

MOU Amendments

This MOU may be amended at any time by written agreement of the Parties. Any amendment must be consistent with the Intergovernmental Agreement. To the extent that a provision of this

MOU reflects specific rights or obligations accepted by another partner under other MOUs with NASA, that provision may be amended only with the written consent of that partner.

Article 21

Language

The working language for all activities under this MOU will be the English language and all data and information generated or provided under this MOU will be in the English language. The foregoing principle does not preclude the use of another language when such use is accepted, in specific instances, as agreed by the Parties.

Article 22

Review

Upon the request of either Party, the Parties will meet for the purpose of reviewing and promoting cooperation in the Space Station. In the process of this review, the Parties may consider amendments to this MOU.

DONE at Washington, D.C., in duplicate, this 29th day of January, 1998, in the English and French languages, each text being equally authentic.

FOR THE NATIONAL AERONAUTICS
AND SPACE ADMINISTRATION OF
THE UNITED STATES OF AMERICA:

FOR THE CANADIAN SPACE AGENCY:

Signed by NASA Administrator

Signed by CSA President

Daniel S. Goldin

William (Mac) Evans